



PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Docket No: Q65937

Hiromi ISHIKAWA

Appln. No.: 09/939,659

Group Art Unit: 2878

Confirmation No.: 4455

Examiner: Shun K. LEE

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For: RADIATION IMAGE READ-OUT METHOD AND APPARATUS

AMENDMENT UNDER 37 C.F.R. § 1.111

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the Office Action dated October 6, 2003, please amend the above-identified application as follows on the accompanying pages.

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AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (currently amended): A radiation image read-out method, comprising the steps of:
 - i) linearly irradiating stimulating rays through a single cylindrical lens onto an area of a stimuable phosphor sheet, on which a radiation image has been stored, with stimulating ray irradiating means, the stimulating rays causing the stimuable phosphor sheet to emit light in proportion to an amount of energy stored thereon during its exposure to radiation,
 - ii) receiving light, which is emitted by the stimuable phosphor sheet, with a line sensor comprising a plurality of photoelectric conversion devices arrayed along the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays, the received light being subjected to photoelectric conversion performed by the line sensor, and
 - iii) moving the stimuable phosphor sheet with respect to the stimulating ray irradiating means and the line sensor and in a direction intersecting with a length direction of the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays,wherein the stimulating ray irradiating means comprises:
 - a plurality of laser diodes located such that laser beams, which have been produced by the laser diodes and act as the stimulating rays, stand in a row along the length direction of the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays, each of the laser diodes being located in an orientation such that a beam spread direction, which is normal to a

junction plane, approximately coincides with the direction, along which the laser beams stand in a row, and

[[a]] the single cylindrical lens for converging operable to converge each of the laser beams, which have been produced by the laser diodes, only in a plane normal to the direction, along which the laser beams stand in a row, and onto the stimuable phosphor sheet.

2. (currently amended) A radiation image read-out method, comprising the steps of:

i) linearly irradiating stimulating rays through a single cylindrical lens onto an area of a stimuable phosphor sheet, on which a radiation image has been stored, with stimulating ray irradiating means, the stimulating rays causing the stimuable phosphor sheet to emit light in proportion to an amount of energy stored thereon during its exposure to radiation,

ii) receiving light, which is emitted by the stimuable phosphor sheet, with a line sensor comprising a plurality of photoelectric conversion devices arrayed along the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays, the received light being subjected to photoelectric conversion performed by the line sensor, and

iii) moving the stimuable phosphor sheet with respect to the stimulating ray irradiating means and the line sensor and in a direction intersecting with a length direction of the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays,

wherein the stimulating ray irradiating means comprises:

a plurality of laser diodes located such that laser beams, which have been produced by the laser diodes and act as the stimulating rays, stand in a row along the length direction of the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays,

[[a]] the single cylindrical lens for converging each of the laser beams, which have been produced by the laser diodes, only in a plane normal to the direction, along which the laser beams stand in a row, and onto the stimuable phosphor sheet, and

optical devices, each of which is located between one of the laser diodes and the cylindrical lens and scatters the laser beam having been produced by the corresponding laser diode.

3. (currently amended): A radiation image read-out method, comprising the steps of:

i) linearly irradiating stimulating rays through a single cylindrical lens onto an area of a stimuable phosphor sheet, on which a radiation image has been stored, with stimulating ray irradiating means, the stimulating rays causing the stimuable phosphor sheet to emit light in proportion to an amount of energy stored thereon during its exposure to radiation,

ii) receiving light, which is emitted by the stimuable phosphor sheet, with a line sensor comprising a plurality of photoelectric conversion devices arrayed along the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays, the received light being subjected to photoelectric conversion performed by the line sensor, and

iii) moving the stimuable phosphor sheet with respect to the stimulating ray irradiating means and the line sensor and in a direction intersecting with a length direction of the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays,

wherein the stimulating ray irradiating means comprises:

a plurality of laser diodes located such that laser beams, which have been produced by the laser diodes and act as the stimulating rays, stand in a row along the length direction of the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays, each of the laser diodes being located in an orientation such that a beam spread direction, which is normal to a junction plane, approximately coincides with the direction, along which the laser beams stand in a row,

[[a]] the single cylindrical lens for converging each of the laser beams, which have been produced by the laser diodes, only in a plane normal to the direction, along which the laser beams stand in a row, and onto the stimuable phosphor sheet, and

optical devices, each of which is located between one of the laser diodes and the cylindrical lens and scatters the laser beam having been produced by the corresponding laser diode.

4. (original): A method as defined in claim 1, 2, or 3 wherein the plurality of the laser diodes are located such that the laser beams, which have been produced by the laser diodes adjacent to each other among the plurality of the laser diodes, stand in a row so as to have an overlapping region, at which the laser beams overlap each other.

5. (currently amended): A radiation image read-out apparatus, comprising:

i) stimulating ray irradiating means for linearly irradiating stimulating rays through a single cylindrical lens onto an area of a stimuable phosphor sheet, on which a radiation image has been stored, the stimulating rays causing the stimuable phosphor sheet to emit light in proportion to an amount of energy stored thereon during its exposure to radiation,

ii) a line sensor, which comprises a plurality of photoelectric conversion devices arrayed along the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays, and

iii) sub-scanning means for moving the stimuable phosphor sheet with respect to the stimulating ray irradiating means and the line sensor and in a direction intersecting with a length direction of the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays,

wherein the stimulating ray irradiating means comprises:

a plurality of laser diodes located such that laser beams, which have been produced by the laser diodes and act as the stimulating rays, stand in a row along the length direction of the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays, each of the laser diodes being located in an orientation such that a beam spread direction, which is normal to a junction plane, approximately coincides with the direction, along which the laser beams stand in a row, and

[[a]] the cylindrical lens for converging each of the laser beams, which have been produced by the laser diodes, only in a plane normal to the direction, along which the laser beams stand in a row, and onto the stimuable phosphor sheet.

6. (currently amended): A radiation image read-out apparatus, comprising:

i) stimulating ray irradiating means for linearly irradiating stimulating rays through a single cylindrical lens onto an area of a stimuable phosphor sheet, on which a radiation image has been stored, the stimulating rays causing the stimuable phosphor sheet to emit light in proportion to an amount of energy stored thereon during its exposure to radiation,

ii) a line sensor, which comprises a plurality of photoelectric conversion devices arrayed along the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays, and

iii) sub-scanning means for moving the stimuable phosphor sheet with respect to the stimulating ray irradiating means and the line sensor and in a direction intersecting with a length direction of the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays,

wherein the stimulating ray irradiating means comprises:

a plurality of laser diodes located such that laser beams, which have been produced by the laser diodes and act as the stimulating rays, stand in a row along the length direction of the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays,

[[a]] the single cylindrical lens for converging each of the laser beams, which have been produced by the laser diodes, only in a plane normal to the direction, along which the laser beams stand in a row, and onto the stimuable phosphor sheet, and

optical devices, each of which is located between one of the laser diodes and the cylindrical lens and scatters the laser beam having been produced by the corresponding laser diode.

7. (currently amended): A radiation image read-out apparatus, comprising:

i) stimulating ray irradiating means for linearly irradiating stimulating rays through a single cylindrical lens onto an area of a stimuable phosphor sheet, on which a radiation image has been stored, the stimulating rays causing the stimuable phosphor sheet to emit light in proportion to an amount of energy stored thereon during its exposure to radiation,

ii) a line sensor, which comprises a plurality of photoelectric conversion devices arrayed along the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays, and

iii) sub-scanning means for moving the stimuable phosphor sheet with respect to the stimulating ray irradiating means and the line sensor and in a direction intersecting with a length direction of the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays,

wherein the stimulating ray irradiating means comprises:

a plurality of laser diodes located such that laser beams, which have been produced by the laser diodes and act as the stimulating rays, stand in a row along the length direction of the linear

area of the stimuable phosphor sheet exposed to the linear stimulating rays, each of the laser diodes being located in an orientation such that a beam spread direction, which is normal to a junction plane, approximately coincides with the direction, along which the laser beams stand in a row,

[[a]] the single cylindrical lens for converging each of the laser beams, which have been produced by the laser diodes, only in a plane normal to the direction, along which the laser beams stand in a row, and onto the stimuable phosphor sheet, and

optical devices, each of which is located between one of the laser diodes and the cylindrical lens and scatters the laser beam having been produced by the corresponding laser diode.

8. (original): An apparatus as defined in claim 5, 6, or 7 wherein the plurality of the laser diodes are located such that the laser beams, which have been produced by the laser diodes adjacent to each other among the plurality of the laser diodes, stand in a row so as to have an overlapping region, at which the laser beams overlap each other.

9. (currently amended): A radiation image read-out method, comprising the steps of:

i) linearly irradiating stimulating rays through a single cylindrical lens onto an area of a stimuable phosphor sheet, on which a radiation image has been stored, with stimulating ray irradiating means, the stimulating rays causing the stimuable phosphor sheet to emit light in proportion to an amount of energy stored thereon during its exposure to radiation,

ii) receiving light, which is emitted by the stimuable phosphor sheet, with a line sensor comprising a plurality of photoelectric conversion devices arrayed along the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays, the received light being subjected to photoelectric conversion performed by the line sensor, and

iii) moving the stimuable phosphor sheet with respect to the stimulating ray irradiating means and the line sensor and in a direction intersecting with a length direction of the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays,

wherein the stimulating ray irradiating means comprises:

a laser diode, which produces a laser beam acting as the stimulating rays, and

[[a]] the single cylindrical lens, which converges the laser beam with respect to one direction in order to form a linear laser beam, and which has a curvature varying over a lens longitudinal direction, such that a beam diameter of the linear laser beam at the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays becomes uniform.

10. (original): A method as defined in claim 9 wherein a plurality of laser diodes are located such that the laser beams, which have been produced by the laser diodes and act as the stimulating rays, stand in a row along a length direction of the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays.

11. (original): A method as defined in claim 10 wherein the plurality of the laser diodes are located such that the laser beams, which have been produced by the laser diodes adjacent to

each other among the plurality of the laser diodes, stand in a row so as to have an overlapping region, at which the laser beams overlap each other.

12. (currently amended): A radiation image read-out apparatus, comprising:

i) stimulating ray irradiating means for linearly irradiating stimulating rays through a single cylindrical lens onto an area of a stimuable phosphor sheet, on which a radiation image has been stored, the stimulating rays causing the stimuable phosphor sheet to emit light in proportion to an amount of energy stored thereon during its exposure to radiation,

ii) a line sensor, which comprises a plurality of photoelectric conversion devices arrayed along the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays, and

iii) sub-scanning means for moving the stimuable phosphor sheet with respect to the stimulating ray irradiating means and the line sensor and in a direction intersecting with a length direction of the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays,

wherein the stimulating ray irradiating means comprises:

a laser diode, which produces a laser beam acting as the stimulating rays, and

[[a]] the single cylindrical lens, which converges the laser beam with respect to one direction in order to form a linear laser beam, and which has a curvature varying over a lens longitudinal direction, such that a beam diameter of the linear laser beam at the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays becomes uniform.

13. (original): An apparatus as defined in claim 12 wherein a plurality of laser diodes are located such that the laser beams, which have been produced by the laser diodes and act as the stimulating rays, stand in a row along a length direction of the linear area of the stimuable phosphor sheet exposed to the linear stimulating rays.

14. (original): An apparatus as defined in claim 13 wherein the plurality of the laser diodes are located such that the laser beams, which have been produced by the laser diodes adjacent to each other among the plurality of the laser diodes, stand in a row so as to have an overlapping region, at which the laser beams overlap each other.

AMENDMENTS TO THE DRAWINGS

In compliance with the Examiner's suggestion, Applicant is submitting herewith one (1) sheet of replacement drawings, which include incorporated changes to Figure 12.

In particular, Figure 12 has been amended to change the reference "12a" to --112a--. The replacement sheet of drawings is intended to replace Figure 12 originally submitted on August 28, 2001. The Examiner is respectfully requested to acknowledge receipt of the replacement sheet.

Attachment: Replacement Sheet